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MILK:
ITS IMPORTANCE AS FOOD

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During the great world war most nations had to conserve carefully their food supplies and to consider the problem of nutrition in a broad general way. Our war experiences have taught us the tremendous importance of proper food in securing and maintaining a high standard in the physical, mental, and moral life of a people. The bad effects of an insufficient amount of food are well known and have been clearly demonstrated. The results of a poorly selected diet, which may be sufficient in amount but of poor quality, may be nearly as bad, tho not quite so generally recognized.

In this bulletin an attempt is made to set forth the superior *quality* of milk as a food, and to emphasize its great importance as a factor of safety in the diets of all human beings, infants, children, and adults, whether sick or well.

THE USE OF MILK ESSENTIAL FOR GOOD HEALTH

That there is a close connection between the diet and the health of an individual is freely admitted. Dr. McCollum of the School of Hygiene, Johns Hopkins University, has devoted his entire time for the past 13 years to the study of nutrition, and has reached the conclusion that milk should be given particular prominence among foodstuffs, because of its unique value as a *protective* food. He says, "It has become evident that milk is the greatest factor of safety in our nutrition, and it is certain we could not have accomplished what we have had we dispensed with milk as food." With this opinion the leading experts on the subject of nutrition agree. According to the views of these men food must do more than satisfy the appetite and supply sufficient calories and protein to meet the bodily needs. It must maintain health by furnishing certain protective substances to the individual. These protective

substances are lacking or are insufficient in most articles of food. They exist abundantly in only two common articles of diet, namely, in milk and in leafy vegetables, such as lettuce, spinach, cabbage, etc. These protective foods are essential not only for the maintenance of health, but also for satisfactory growth in the young. Leafy vegetables are not nearly as well adapted for protective foods for man as is milk, principally for the reason that they cannot be consumed in sufficient quantity.

McCollum believes that the achievements of any race of people in science, art, and literature depends more on the milk consumption of that people than on any other factor. In other words, a nation that consumes milk liberally is bound to be a healthy, virile, and productive nation. "The Chinese, Japanese, and the peoples of the tropics generally have employed the leaves of plants as almost their sole protective food. They are characterized by small stature, relatively short span of life, high infant mortality, and by continued adherence to the employment of the simple mechanical inventions of their forefathers." It is said that the Japanese child, fed without cow's milk, requires two or three years longer than the American to reach maturity, while the Japanese farmer of 60 corresponds in health and vigor to the American of 80 years of age.

Several diseases which afflict mankind are known to be caused by a faulty diet. Beri-beri, prevalent in the Orient among peoples subsisting almost entirely on degerminated grains, and characterized by extreme nervous debility and degeneration, disappears when protective foods are added to the diet. Pellagra, which is common in localities where the diet is poor, especially where meal made from degerminated corn is used as the chief food, is practically unknown in regions where the protective foods are consumed in liberal amounts. Scurvy appears only among people restricted to a diet of preserved foods devoid of fresh fruits, vegetables, milk, and meat. Rickets is common among the children of the very poor who live on a diet of degerminated wheat, corn, and rice together with tubers and meats. It is quite possible that there is a close connection also between faulty diet and tuberculosis. McCollum says, "An examination of any large groups of people in the cities will show that where there is a high mortality from tuberculosis, milk is not being used to any great extent, and in any large group where milk purchases are large this disease is not a menace. It is well known that in institutions where tuberculosis is successfully treated milk forms the principal article of the diet of the inmates."

DO WE USE SUFFICIENT MILK IN THE UNITED STATES?

There is produced in this country almost exactly 1 quart of milk a day for every man, woman and child. At a glance it would seem that this would be enough to supply every person in the land with a liberal allowance. As a matter of fact there are relatively few individuals who consume as much as a quart of milk a day; indeed, there are great numbers who use no milk at all. In the first place nearly half of the milk produced is used in making butter; the skimmilk from which the cream is secured is largely fed to farm animals or wasted. Approximately half of the milk produced, or a pint a day per person on an average, is consumed as raw milk, condensed milk, or ice cream.

As a whole, dairy products furnish about one-sixth of the total food of the average American. The situation in regard to the supply of milk and its products appears to be gratifying when considered in this general way. We should remember, however, that there is a very unequal distribution. In a very careful and extensive study of the milk situation it is estimated in Bulletin 56, United States Treasury Department, Hygienic Laboratory, that in 1900 the average per capita consumption of milk in the cities of the United States was only ½ pint per day. It is probable that the use of milk has decreased rather than increased since that time owing to the advance in price. The Massachusetts special Milk Report for 1915 mentions a New England city of 120,000 having a total daily milk consumption of 27,000 quarts, less than a half-pint per person per day. The infant mortality rate was 171 per year for each 1,000 babies. Raw milk was used for infants in very much smaller amounts than it should have been, condensed milk, beer and coffee being substituted instead. In one city of the United States where milk was generously used the infant mortality rate for the year 1918 was only 35 per 1,000. One of the most important factors in reducing infant mortality is plenty of good clean milk.

The average American consumes about ½ pound of meat a day, that is, about as much meat by weight as of milk. Experts who have studied the problem carefully believe that there is no justification, as far as health is concerned, for this large meat consumption. It is believed by practically all authorities that the best interests of health and of economy would be served by reducing the use of meat and increasing the use of milk. Professor Sherman of Columbia University gives the following estimate of the average

American food budget at present and recommends that changes in food selection be made according to the expenditures given in the second column of the following table:

AMERICAN FOOD BUDGET AS IT IS AND AS RECOMMENDED BY PROFESSOR HENRY C. SHERMAN

FOOD	Average expenditures of American family	Expenditures recommended for ideal diet
	Percent	*Percent*
Meat and fish	35	12
Eggs	6	6
Milk	10	30
Cheese	1	3
Butter and other fats	9	11
Bread and cereals	15	13
Sugar	5	3
Vegetables and fruits	13	17

It must be admitted that Professor Sherman sets a high standard for the use of milk. Families of low income are, obviously, forced to buy largely the cheapest foods, namely, flour, cereals and meals prepared from cereals, for the price of these articles is always relatively low. These families often have difficulty in obtaining a sufficient *quantity* of food and are forced to sacrifice *quality* more or less. They must increase the use of bread and cereals and reduce meat, eggs, and the more expensive fruits and vegetables.

Two good rules for families of any income are (1) to spend at least as much for milk as for meat, (2) to spend as much for fruits and vegetables as for meat. It is a calamity, indeed, when the family income is so low that meat and milk both must be eliminated from the bill of fare. Meat can be eliminated without danger to health provided milk is still used. In fact, many believe that such a change in food habits would have a beneficial result. When meat and milk are both eliminated, on the contrary, grave danger to the health of the consumer results.

A survey made in the tenement district of New York City during 1917 among 2,200 families, all containing children under six years of age disclosed the fact that as an average ½ pint of milk per person per day was being used. Over half of these households had reduced the consumption of milk over the previous year. In over three-fourths of these cases where milk had been reduced, tea and coffee had been substituted for milk and the mothers stated either that the children were not gaining or that they were losing

weight. Children require a more nutritious diet than adults do, and the results of a poor diet are more quickly evident in the young than in the full-grown.

Many hold the notion that milk, while indispensable for infants and invalids, is not a suitable food for healthy adults. They consider that a healthy full-grown man needs to apologize for taking baby food. While it is a fact that milk is indispensable for infants and invalids it is equally as true that there is no other food as nourishing and health-giving for robust men and women. If all could become convinced of this truth and recognize the superiority of milk over meat and the high value of milk as a common every-day food for healthy grown people as well as for infants, children and invalids, there would be a marked improvement in our national health and vigor.

Dr. Holt in 1917 testified before the Mayor's Committee on Milk (New York City) as follows: "For infants during the first year, a quart of milk a day is necessary; for the second year a pint and a half. For children between the ages of 2 and 6 years, the daily ration of milk should be a pint a day as a minimum. I should think that after 6 years of age up to 12 or 13 years, a pint of milk a day ought to be allowed to all children." Professor Sherman testifying before the same committee said: "We cannot expect a good community dietary if that community uses less than ½ quart of milk per capita per day." These recommendations are based on the smallest amounts of milk compatible with health. The quantities should be increased rather than diminished. Many authorities recommend a quart a day for every child up to 12 years of age and a pint a day for every person over 12 years. The writer believes that if milk was used by every one according to the latter rule there would be a wonderful improvement in health. It would mean, of course, a decided increase over the present consumption of milk.

THE USE OF MILK ON THE FARM

Most of the studies on the consumption of milk have been made in cities, and we have practically no information as to the average amount of milk used by the farmer as food for his family. The writer believes that milk is more freely used in the country than in the city. Unfortunately, however, there are many farms where milk, tho plentiful, seldom appears on the table. Anything that can be said regarding the food value of milk applies to its use on the farm as well as to its use in the city, and there is this fact in addition—milk costs the farmer about one-half as much as it costs

the city man. No farmer can afford to neglect the free use of milk as a food for his family.

Milk is not only a substitute for meat, it is an improvement over meat. The free use of milk on the farm means reduced food bills, but more important than this, it means better health, greater capacity to work, and an increased joy in life. The farm housewife, at small expense, can use milk and cream freely in cooking, and insure a superior quality to the food on her table. Milk used in cooking gives full value in nourishing the family, and such use is a wise practice which should be extended rather than curtailed. In the majority of farm homes visited by the writer, milk does not appear regularly on the table as a drink. A pitcher of milk freely passed around and a glass at every place is the best health insurance a farmer can have. Whole milk is best, but skimmilk is excellent. We all know how well pigs and chickens thrive on milk—even skimmilk. It is certain that milk is as beneficial for man as for farm animals.

We use tea and coffee entirely for the pleasurable sensation given by the beverages. They have no food value aside from the sugar and cream used with them. In fact, tea and coffee become deleterious to health when consumed excessively, and are detrimental to children in any quantity. Milk as a beverage, on the contrary, has a high food value, insures good health, and in the long run gives greater pleasure than either tea or coffee.

FOOD CONSERVATION AND MILK PRODUCTION

Our recent war experiences have taught us to think of our food resources in terms of food value as a national and world supply. We have been face to face with a world food shortage, and we in this country have shared our food supplies with less fortunate peoples overseas. We have had a demonstration of what it means to feed more mouths than we ever had to feed before. The problem of food conservation is by no means settled with the signing of peace. To be sure it is made less pressing, but in another form the problem of conserving food supplies will grow as the years pass by. A few facts, most of them self-evident, will make this plain:

(1) The tillable land of the United States is limited. Most of it is already under cultivation.

(2) Yields per acre may be increased by better methods of farming, but it is difficult to push up average yields and impossible to advance them beyond certain limits.

(3) The population of the United States has increased almost steadily since the Revolutionary War at the rate of 20 percent for each 10-year period. If this rate of increase continues up to the end of the present century our population then would be approximately 500,000,000, considerably greater than that of China at the present time. While we may doubt that such a rate of increase can continue until the year 2000 we must admit that our population is growing rapidly and that the question of an adequate food supply will be more difficult as the years go by.

(4) Human beings and domestic animals are nourished, in general, by the same materials. Wheat, corn, oats, rye, roots, tubers, and fruits may be consumed directly by man or they may be fed to animals, the animal products—meat, milk and eggs—thus obtained being used as food by man.

(5) The conversion of grain into meat, milk, or eggs involves great but unequal losses in food value. For example, a bushel of corn, weighing 56 pounds, fed to a steer will produce from 5 to 8 pounds increase in live weight. When we consider that about one-half of this live weight represents waste, i. e., bone, entrails, etc., and that clear meat is about three-fourths water, we must conclude that our 56 pounds of corn actually produces from 1 to 2 pounds of edible dry solid matter when converted into beef. The hog is about five times as efficient as the ox in converting grain into meat. The dairy cow beats them both in her ability to convert grain into highly digestible food for man.

(6) The dairy cow can be fed to a large extent on feeds unsuitable for direct human use, such as hay and the by-products of mill and factory. Hence, practically the full food value of the grain fed to a cow may be recovered in the milk produced. That is to say, the dairy cow utilizes coarse feeds more economically than any other farm animal, and that portion of her ration which might be used directly as food by man may be recovered entirely in the milk.

From the point of view of food conservation, then, the dairy cow helps us to utilize economically our national food resources, because she utilizes feeds otherwise wasted, and converts coarse grains which could not be digested well by man into an easily digested and highly nourishing product. A reduction in the use of meat and an increase in the use of milk is desirable, therefore, both in the interest of health and in the conservation of national food supplies. Meat, to be sure, is an excellent food, and there is no objection whatever to its use in moderation.

MILK AS A POSSIBLE CARRIER OF DISEASE

Milk as it exists in the udder of the healthy cow is practically free from bacteria. In the process of milking more or less bacteria always get into the pail, depending on the cleanliness of the cows, stable, and milker. Milk, especially warm milk, is a favorable medium for the rapid multiplication of these bacteria, and unless precautions are taken milk sours rapidly because of the substances, principally lactic acid, produced in the milk by the bacteria. Usually the lactic acid producing bacteria are the principal ones in milk, but others are present also, some of which may produce strong, unpleasant odors and flavors.

Disease germs occasionally get into milk, either directly from a diseased cow or indirectly from a sick person, from a polluted well, or in some similar way. The problem of supplying clean, sweet milk, free from disease germs, has been a very difficult one for our cities to solve. It is essential that all who handle milk should understand that care and cleanliness are required in keeping it pure and safe. Furthermore, it is important to remember that bacteria multiply rapidly in warm milk, but in cold milk the number of germs does not increase nearly so fast. Care, cleanliness, and cold are essential in producing and handling milk. Fortunately, disease germs are easily killed by heat, a temperature of 140° Fahrenheit continued for 20 minutes being sufficient to destroy all such germs in milk. Boiling, of course, destroys disease producing bacteria, but at the same time heating in this way changes the flavor of milk, giving it a cooked taste. Most of our larger cities now safeguard their milk supplies by subjecting the milk to the pasteurization process, which consists in heating the milk to a temperature of 140° Fahrenheit, at which point it is held for about 20 minutes, or by heating to a higher temperature for a shorter time and cooling quickly. Pasteurized milk, if properly handled after being pasteurized, is free from all danger and is not devitalized in any way. It is estimated that about 10 percent of the cows of the United States are affected with bovine tuberculosis, and there may be danger, especially in infants, that human beings may become infected with this disease thru the use of milk from tuberculous cows. It is wise, therefore, even on the farm to pasteurize all milk fed to infants. Diseased animals should not be tolerated and the milk from only healthy cows should be used as food. In all that is said in this bulletin concerning the food value of milk it is assumed that the milk is produced from healthy cows under sanitary conditions and that the product is properly handled from the time it is drawn until consumed.

REASONS WHY MILK IS THE BEST FOOD

The diet of man must contain many things to insure the perfect nourishment of his body. In one sense the body of man is a machine, and a comparison with the gas engine has often been used to help explain the action of food in the body. The gas engine requires (1) fuel to supply power, (2) material to repair the various parts so as to keep the mechanism in good working order, and (3) oil to lubricate the bearings so that it may run smoothly without excessive wear. So the human machine requires (1) fuel to supply power for work and heat to keep the body warm, (2) repair and constructive material to keep the bodily machinery in good running order and for growth, and (3) small amounts of substances called vitamines whose function has been likened to that of the oil in the gas engine. In addition, the diet should contain roughage or indigestible matter to insure the regular elimination of waste from the intestine.

The young animal has capacity, unlike the gas engine, to grow, and all three kinds of materials are required for this process, proper food for the young being the same as for the adult except that during growth more repair and constructive material and vitamines in proportion to fuel must be supplied. Milk is the most excellent food because it supplies all the needs of the body. It is a fuel food, a growth and repair food, and it contains vitamines in larger amounts than any other food known.

FOOD AS FUEL

Fuel must burn in order to give up its latent power or energy, so food is burned, or as we say oxidized, in the body. The oxygen absorbed from the air in the lungs takes a part in this burning or oxidation, and heat and muscular power are produced along with certain chemical products. The fuel value of coal, wood, sugar, fat, or any food can be measured easily. The unit used to measure fuel value is known as the calorie, and it represents a certain amount of heat, enough to raise the temperature of 1 pound of water 4° Fahrenheit. It is about as easy to measure fuel value with the calorie standard as it is to measure cloth by the yard or wheat by the bushel. The amount of fuel food required by a person depends on the age, size, and activity of the individual. A child requires more in proportion to size than an adult, a large person more than a small one, and an active man more than one who is not working. If the food eaten does not supply enough fuel to meet the needs of the person, some of the material already in the body, principally

fat, will be used up and there will be a loss in weight. If the food contains an excess of fuel there will be a storage of fat in the body with a gain in weight. One can tell, then, in a general way whether the diet is sufficient in fuel value by observing the body weight for a period of several weeks.

Milk is an expensive *fuel* food because the average man would require about 5 quarts of milk daily if he ate nothing else in order to do full work and maintain his weight. Bread, cereals, potatoes, sugar, and fats are much cheaper fuel foods, and hence we should rely chiefly on these substances for fuel. Milk has its great value as a food not because of its *fuel* value, but rather because of its ability to repair waste tissue, to supply material for growth, and to keep the bodily machinery in good working order and to keep it running smoothly.

FOOD AS REPAIR AND CONSTRUCTIVE MATERIAL

Sugar, starch, and fat are excellent fuel foods, but are *not* suitable for the *repair* of waste or the *growth* of new body substance. The reason for this is evident. The active parts of the body, the muscles and organs, are composed not of sugar, starch, or fat, but of another substance known as protein. Protein likewise is the chief constituent of the white of the egg and of blood. Protein food, then, must be fed liberally in order that young animals may grow rapidly and that both young and old may maintain strong, healthy bodies. Besides protein, certain minerals are also required for repair and for constructive purposes. For example, the bones consist largely of phosphate of lime, and minerals are present in all tissues of the body as a constituent part. The minerals required in largest amounts are sodium chloride or common salt, lime, potash, magnesia, iron, phosphorus, and sulfur, with traces of others, such as iodine and manganese. The minerals serve a dual purpose in that they are required for repair and growth and also are necessary as lubricants, so to speak, which help to regulate the body processes and to keep all parts in good working condition. A good supply of these salts in the food is absolutely necessary for normal growth and for the maintenance of health.

Milk is the best food for growth and for repair of tissues because it contains large quantities of protein and salts required in these processes. In fact, there is no other food which contains both protein and all the salts in sufficient amounts to meet the needs of the body. The only deficiency of milk known is in respect to iron. This mineral is not abundant in milk. Iron, however, is

well supplied by cereals, fruits, and vegetables as well as by meat and eggs, so that in an ordinary diet a person would not suffer because of too little iron. The protein of milk, meat, and eggs is of a superior quality, being very similar to the protein of the body, while the proteins found in cereals, beans, and vegetables is quite unlike body protein and of poor quality. Children can not grow properly on the proteins of cereals, beans, tubers, roots, and fruits. It is essential that they have a liberal allowance of milk protein. Adults, to be sure, may secure plenty of good protein from meat, but milk protein is as cheap or cheaper, and at the same time milk supplies the minerals needed which are lacking in meat.

A quart of milk contains a little more than 1 ounce of protein, approximately as much as there is in 6 ounces of meat or in 1 pound of bread. It is known that men can keep in good health and vigor when the diet supplies as little as 2 ounces of protein. A quart of milk a day practically meets the need of children under 6 years for protein, and supplies about half the requirement of the adult. During the periods of infancy, childhood, and adolescence milk protein is by far superior to that found in any other food. By all means milk should be fed liberally thruout this time in order that a strong, robust body may be developed.

A careful study of foods has revealed the fact that most of the common articles of diet are very low in lime. Meat, tubers, roots, most fruits, cereals, and beans all contain too little lime to meet the requirements not only of children, but even of adults. A survey of conditions in many families has shown that a large proportion, probably at least one-fourth, of the people of the United States suffer impaired health and vigor because their daily food does not supply sufficient lime. Indeed, there is reason to believe that lime deficiency in the diet is more common than protein deficiency. Milk is exceptionally rich in lime. A pint of milk contains as much lime as 4½ pounds of bread, 12 pounds of meat, or 10 pounds of potatoes. Further, a pint of milk contains nearly as much lime as is required in a day by the average man. The lime requirement of growing children is relatively very high on account of the growth of bone and other tissues which is taking place. A pint of milk a day in the diet of every person insures safety against a possible deficiency of lime, which might result in lowered vitality, disease, and an untimely end. Besides lime, milk supplies the other minerals required, with the exception of common salt and iron. As a source of protein and minerals, then, milk in the diet in generous amounts assures safety in properly supplying the needs of the body for these repair and constructive materials essential for growth

in the young and for the maintenance of health and strength thruout life.

VITAMINES

Since 1912 a great interest has developed in these substances, and many experiments have been made in order to learn more about them. In 1912 an English experimenter found that young animals fed on a mixture of pure protein, fat, carbohydrate (starch), and minerals did not thrive; in fact, while they ate the food with relish, they appeared to starve to death. He made the interesting discovery that the addition of a very small amount of milk to the food mixture started the animals growing at the normal rate. He saw that milk must contain something besides protein, fat, carbohydrate (sugar), and minerals, something necessary for growth and the maintenance of health, but something unknown up to that time. This discovery is the most important one made in recent times in the subject of food chemistry. It gives us an entirely new conception of food values, enabling us to appreciate certain foods as we never could before and to understand the shortcomings of others.

These newly discovered substances have been called vitamines. We do not know at present just what vitamines are like, but there is no doubt as to their existence nor as to their effects on animals. Three of these vitamines have been discovered so far, possibly there are others. One of them is associated with certain fats such as milk fat, egg-yolk fat, and cod liver oil. This fat-soluble vitamine, known as fat-soluble A, is also abundant in green leaves. The second vitamine is widely distributed in the germs of seeds, in yeast, in milk, and also in green leaves. It dissolves in water and is known as the water-soluble B vitamine. The third vitamine is found principally in fresh fruits, vegetables, and milk. It is soluble in water and is known as the water-soluble C vitamine. Its presence in the diet protects against scurvy. All of these vitamines must be present in the diet in sufficient amounts. The actual amounts required are extremely small, yet they are absolutely essential.

The vitamines can not serve as fuel. They probably do not serve as repair or constructive material. Rather they appear to act as regulatory substances which in some way keep all parts of the system in good working order. Milk is the one common food which supplies all vitamines in abundance. Green leaves approach milk in respect to vitamine content. The amount of green leaves required to supply sufficient of the vitamines for mankind appears to be excessive, however, for the human digestive apparatus to

handle well. Milk stands out above all other foods, therefore, as a source of vitamines for man, and the liberal use of milk insures safety from vitamine starvation. A pint of milk a day appears to contain sufficient vitamines to insure good nutrition in adults, probably also in children. In considering the food value of milk we should keep in mind that milk is not only a *fuel* food and a *repair* and *constructive* food, but also that it is a *protective* food high in vitamine content, and that its liberal use promotes growth and protects against disease.

MILK AS FOOD FOR INFANTS

Obviously the most satisfactory food for infants is that provided by nature, mother's milk. Unfortunately many mothers find it impossible to nurse their babies and artificial feeding must be resorted to. For bottle-fed babies, cow's milk must be substituted for mother's milk and the tremendous importance of the dairy cow as the foster mother of mankind can not be overstated.

Cow's milk and human milk, while alike in a general way, are very different in certain respects. The principal differences are: (1) cow's milk contains about twice as much protein as does human milk, (2) cow's milk contains about three times as much mineral salts as human milk, (3) cow's milk contains less sugar than human milk, (4) cow's milk curdles in the stomach in large dense curds, human milk curdles in small flakes, (5) the fat droplets in human milk are smaller than in cow's milk. The total solids and percentage of fat in the two milks is about the same. The infant during the first few months of life cannot digest cow's milk in its natural state because of these differences, hence cow's milk must be modified by dilution and otherwise in order that satisfactory results may be obtained. It is beyond the scope of this bulletin to attempt to give any specific directions for modifying milk for infant feeding. Such information may be obtained from a number of good books and bulletins on the subject, among which the bulletin on Infant Care, published by the Children's Bureau of the United States Department of Labor, can be recommended.

MILK FOR CHILDREN

Every one admits that milk is indispensable for infants, but there is a rather general belief that after the first year milk is no longer necessary, or at least that the amount of milk can be greatly reduced with safety. This is a great mistake. During the period of childhood up to 12 years of age, growth should go on steadily and rapidly. In order to secure this, the food of the child

must be easily digested and rich in growth-producing materials, proteins, mineral salts, and vitamines. Milk is the only article of food that meets these requirements; in fact, a combination of any other foods can not take the place of milk during this period of life.

Many children, because of poor nourishment during childhood, are so weakened in health and their physical development is so impaired that they never recover from the effects even tho they live to manhood and womanhood. In many cases the cause of much suffering and misery among children is due to improper feeding, often not recognized as such. A quart of milk a day for each child up to the age of 12 is a good and a safe rule. Of course, milk should not be the only article of food, yet it should constitute the basis of the diet. It is the duty of the parents to provide the milk and see that the children drink it. Sometimes persuasion and argument are necessary to get an unwilling child to take the milk that is really good for him. Occasionally a child has an aversion to drinking milk that can not be overcome. In this case the mother should cook for the child as many dishes with milk as possible, and encourage the use of milk on cereals and fruits. Plenty of milk in the diet during childhood is the best prescription that can be given for the child. Strong, sturdy bodies can not be developed on an improper diet, and food chemists are perfectly sure that milk is such a good food and so beneficial in its effects on children that every child in the land should have plenty of milk with every meal, every day in the year.

MILK FOR ADULTS

Every one admits that milk is indispensable for infants, many even agree that all children up to 12 years ought to have milk, but most people say that milk is not at all necessary for adults. Of course, adults can live without milk, but that it not the point. A horse or cow can *live* on straw and nothing else, but it is a miserable life for the animal. Many people who believe that they eat the proper food and plenty of it are really poorly nourished and suffer much pain because of it. It is safe to say that practically all of these poorly nourished people use very little milk. The standard diet of meat, potatoes and bread, so common in the United States, is very low in lime and deficient in vitamines. Experts believe that a man can not keep in the best physical condition on such a ration. A pint of milk a day makes good the deficiencies in the above diet, and at least that amount of milk ought to be used by every youth and adult. There are a few who can not take milk as a beverage

for one reason or another. Such persons should use milk very liberally in cooked foods, for milk consumed in this way has practically the same food value as when taken as a beverage.

THE VALUE OF MILK IN MAINTAINING A HEALTHY CONDITION IN THE INTESTINE

Bacteria are present in enormous numbers in the lower bowel of man. It has been estimated that one-third of the residue ejected from the intestine is made up of these organisms. Now these bacteria are of different types, some of them being practically harmless, others producing substances which are distinctly toxic. These toxic substances may be absorbed into the system and produce very harmful results, even permanent injury to the individual harboring the bacteria. The good effects of purgatives and laxatives, physics and pills, are due in large measure to their cleansing action on the intestine. The use of drugs in this way is of little permanent benefit. If the diet is unchanged the same kind of bacteria develop again and trouble returns. Stools having a very offensive odor are a sign of a bad condition in the large intestine. The stools of the breast-fed infant ordinarily are inoffensive. Bacteria in large numbers are present, to be sure, but they are of a type which do not produce large amounts of toxic substances. Milk is known to be beneficial in keeping out those harmful kinds of germs.

The generous use of milk, then, tends to improve the sanitary condition of the digestive tract and to control the growth of those harmful bacteria which are prone to develop when the diet consists of meat, potatoes, and bread. The well known good effects of fruits and such vegetables as carrots, parsnips, and turnips, are probably due in large part to the effect which they have in developing a harmless race of bacteria in the intestine and thus keeping out the trouble makers. For the sake of good health milk, fruits, and certain vegetables should be used freely. Milk, with many persons, has a constipating effect which is counteracted by fruits and vegetables, so the combination of foods is most desirable.

THE SPECIAL VALUE OF SOUR MILK AND BUTTERMILK

A few years ago a noted man, Professor Metchnikoff of the Pasteur Institute of Paris, wrote a book entitled "The Prolongation of Life." In this book he strongly advocated the use of sour milk as an article of diet. He had observed that in the Balkan States, particularly in Bulgaria, where the use of sour milk was common, there seemed to be an unusually large number of old people in pro-

portion to the population and he attributed this to the sour milk diet. In these countries milk is commonly soured by a kind of bacteria known as bacillus Bulgaricus, and is two or three times as sour as the ordinary sour milk as we know it. Metchnikoff believed that it was the lactic acid in the sour milk which had the beneficial effect on the human system. His writings had a profound effect and the use of soured milks as beverages came into vogue. Many experiments have failed to support his claim in regard to the good effects of lactic acid. It appears that the benefits derived from sour milk are practically the same as those from sweet fresh milk. Sour milk, buttermilk, and sweet milk are all good food, practically equal in food value. There does not seem to be any especial virtue in these soured products unless they happen to be more palatable and appetizing to the individual taste.

CONDENSED MILK AND MILK POWDER

These products are concentrated milk, that is, milk from which more or less of the moisture has been removed by evaporation. Condensed milk has about double the food value and milk powder nearly eight times the food value of fresh milk. Milk powder, however, is usually prepared from skimmilk, hence its food value should be compared to skim rather than to whole milk. Condensed milk and milk powder are excellent foods, tho unfortunately there is danger that they are partly devitalized by the heating employed in their manufacture, losing thereby a part of their vitamines. Such milks should not be used for infant feeding, nor for young children to the exclusion of fresh milk. They have an important place, however, in cookery and in the adult diet where the demand for vitamines is not so great as in the young. They should not be used even by adults as replacing fresh milk entirely.

MILK AS AN ECONOMICAL FOOD

In considering the cost of foods as compared with their nutritional values we should keep in mind that milk stands in a class by itself in being a complete food and in having unique protective properties. It is almost impossible to put a cash value on these properties. One authority has said that whatever value you put upon good health, that is the price you can afford to pay for milk. If it were possible for one to maintain good health on such a simple diet as cornmeal mush alone the problem of cheap living would be solved, because 2 pounds of cornmeal, costing perhaps 10 cents, would be sufficient in bulk, in fuel value, and in amount of protein to supply the food needs of an adult man for a day. Such a diet however, would be lacking in palatability, lime, and vitamines. It

would have a digestibility too low for the best interests of health and would be too bulky, the 2 pounds of cornmeal making about 10 pounds of mush. The fuel value and protein content of foods are easily measured and comparisons on these grounds are readily made. Some of them are presented for their general interest:

TABLE I.—RELATIVE COST OF FOODS AS A SOURCE OF FUEL

FOOD	COST	Amount required to furnish 3000 calories*	Cost of 3000 calories*
Milk	14c qt.	4.9 qt.	$ .67
Bread	8c lb.	2.5 lb.	.20
Wheat flour	7c lb	1.9 lb.	.13
Pork chops	35c lb.	2.4 lb.	.84
Veal cutlet	35c lb.	4.5 lb.	1.35
White fish	25c lb.	9.5 lb.	2.38
Beef steak	35c lb.	2.4 lb.	.84
Apples	5c lb.	14.0 lb.	.70
Potatoes	4c lb.	10.0 lb.	.40
Sugar	10c lb.	1.7 lb.	.17
Lard	30c lb.	.74 lb.	.22
Eggs	50c lb.	3.3 doz.	1.65

*3000 Calories is the fuel value required by the average man per day.

As a source of fuel, milk is rather costly, but not as expensive as meat, fish, or eggs. Bread, the cereals, sugar, and the fats such as lard, are the cheapest fuel foods and hence these articles should be relied on for nourishment as far as safety in health permits.

TABLE II.—RELATIVE COST OF FOODS AS SOURCES OF PROTEIN

FOOD	COST	Amount required to furnish 3 oz. of protein*	Cost of 3 oz. of protein
Milk	14c qt.	3 qt.	$ .42
Bread	8c lb.	2 lb.	.16
Wheat flour	7c lb.	1.6 lb.	.11
Pork chops	35c lb.	1.4 lb.	.49
Veal cutlet	30c lb.	1.0 lb.	.30
White fish	25c lb.	1.8 lb.	.45
Beef steak	35c lb.	1.0 lb.	.35
Apples	5c lb.	62.0 lb.	3.10
Potatoes	4c lb.	10.0 lb.	.40
Sugar		No protein present	
Lard		No protein present	
Eggs	50c doz.	1 doz.	.50
Dried beans	12c lb.	.8 lb.	.10
Cheese	40c lb.	.7 lb.	.28

*Three ounces of protein is the amount required per day by the average man.

As a source of protein the cereal foods and beans are by far the cheapest foods. The protein in both of these is decidedly inferior in quality, still, for adults, good health can be maintained when

the major portion of the protein is supplied by these products.

The interests of health demand that part of the protein be supplied by meat, milk, or eggs. It is seen that at the prices quoted milk compares favorably with meat and eggs. The cheaper cuts of meat supply protein somewhat more cheaply than does milk, while eggs are more costly. These tables do not consider the protective value of milk at all and it is this feature that gives to milk its outstanding high food value. It seems certain that a quart of milk for each child under 12 years and a pint a day for all other persons, taken with the customary mixed diet will give adequate protection and safety in nutrition. We wish to repeat the rule: "Every family of limited means should spend equal sums for the three items: (1) milk, (2) meat, and (3) fruits and vegetables." Meat may be eliminated entirely if economy demands; the cheaper fruits and vegetables may be used to the exclusion of the more expensive, but by no means should milk be stricken from the bill of fare.

HOW MILK MAY BE USED IN THE DIET

When the chemistry of nutrition and physiology of digestion determine the needs of the body and the foods which will supply these needs, the food problem has not been disposed of. Preparation of such foods follows close on their heels and claims a position of importance. In our present state of civilization we demand freedom from monotony in the matter of foods as well as in our manner of amusement and dress. Unfortunately, the desire for a generous round of as worthy gratifications as our endowments, tastes, and circumstances may afford often goes unsatisfied at our tables because of the needless limitations placed upon the preparation of our food.

Perhaps no other food lends itself to a greater variety of ways of preparation than does milk. As a drink, hot or cold, with or without the addition of accessories, milk serves not only as a beverage, but as a food. It is the basis of all cream soups, to which is added a little flour, mashed or strained vegetables. The quality of creamed, escalloped and combination dishes is dependent upon a generous use of milk. Many cheese recipes are incomplete if this one food item is omitted. Gravies are varied by the use of milk. A long list of desserts, puddings, pies, ice-creams, and custards may be developed by using milk either as a basis or as a sauce. Cottage cheese, which was given a place in the limelight during the recent war, is a derivative of milk and serves well as a meat substitute. All of the cereals, in whatever way prepared, can be effectively supplemented by good, rich milk.

BULLETIN SUMMARY

1. Milk is a *protective* food, and as such is in the class of those foods whose liberal use protects health and promotes growth. It excels all other protective foods, being approached in value only by fresh, green, leafy vegetables such as lettuce, spinach, etc. The liberal use of milk is the best dietary precaution for maintaining good health in all individuals, and for promoting rapid, healthy growth in the young.

2. The use of milk in the United States should be considerably increased. A pint of milk a day for each youth and adult and a quart a day for each child under 12 is a good standard. If the family income is low the use of meat may be largely reduced or eliminated altogether with safety to health, but under no circumstances should the use of milk be reduced below a pint per person per day.

3. Milk is relatively cheap on the farm. The farmer's family should use it more liberally in cooking and as a drink. Such an increased use of milk is economical and leads to better health on the farm.

4. From the standpoint of food conservation the production of milk is much more economical of feed and fodder than the production of meat. The substitution of milk for meat in the diet not only tends to improve the health of the consumer, but also to conserve the country's food supply.

5. Milk, to be fit for human use, should be produced from healthy cows under sanitary conditions. It should be carefully handled until consumed.

6. Milk is the most excellent food known because it is a *complete* food. It supplies energy and protein and, most important of all, it contains large quantities of mineral matter and of vitamines which are lacking in most foods, but without which nutrition fails.

7. Milk is indispensable for infants.

8. Children between the ages of 2 and 12 years are likely to suffer injury to health and strength if fed without milk.

9. Adults can *live* without milk. Health and vigor are improved, however, when the diet of every adult contains at least a pint of milk per day.

10. The liberal use of milk tends to maintain a sanitary condition in the digestive apparatus and to keep out those bacteria which produce toxic substances and which tend to bring on a condition known as auto-intoxication.

11. All things considered, milk is an economical food. As a source of protein it is as cheap as or cheaper than foods of equal quality such as eggs, fish, and meat. As a fuel-food milk is not nearly so cheap as the cereals and fats, hence these should be depended upon chiefly for the supply of bodily heat and for muscular energy. As a protective food milk excels all others. In the interest of health we can not afford to neglect the use of milk.

12. Milk used in cooking has the same food value as milk taken raw. Suggestions are made for the use of milk in various dishes prepared in the home.